



Mount Rainier National Park

Sister Mountain Project

Glaciers—Nature’s Ice Sculptor

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| Overview | Students will research the effects of glaciers on mountain landscapes. Using what they learn they will then view images of Mount Rainier and Mount Fuji topography to draw conclusions regarding the presence or absence of glaciers on each of the mountains. |
| Grade Level | 7-12 |
| Objectives | <p>Students will be able to:</p> <ul style="list-style-type: none">• Use images and print resources to research and explain the impact of glaciers on landscape• Analyze images for information and recognize patterns• Compare and contrast patterns observed at Mount Rainier with patterns observed at Mount Fuji• Summarize the results of their research to predict the presence or absence of glaciers on Mount Rainier and Mount Fuji |
| Setting | Computer lab or in a classroom with internet access |
| Timeframe | 2 50-minute class periods (1 to complete the webquest, 1 to analyze images) |
| Materials | 1 copy of webquest page per student 1 copy of map/image packet per group Internet access |
| Vocabulary | Glacier, perennial, arête, cirque, crevasse, debris flow, esker, fjord, glacial trough, glacial outburst flood, horn, kettle lake, lahar and moraine |
| Standards | <p>Science</p> <p>6-8-SYSA— Given a system, identify subsystems and a larger encompassing system</p> <p>6-8-INQC--Recognize and interpret patterns – as well as variations from previously learned or observed patterns – in data, diagrams, symbols, and words.</p> <p>6-8-INQG--Prepare a written report of an investigation by clearly describing the question being investigated, what was done, and an objective summary of results. The report should provide evidence to accept or reject the hypothesis, explain the relationship between two or more variables, and identify limitations of the investigation.</p> <p>6-8-ES2G-- Explain how a given landform (e.g., mountain) has been shaped by processes that build up structures (e.g., uplift) and by processes that break down and carry away material (e.g., weathering and erosion).</p> |

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| | <p>6-8-ES3D--Interpret current landforms of the Pacific Northwest as evidence of past geologic events</p> <p>Social Studies Geography 3.1.1</p> <p>3.1 Understands the physical characteristics and location of places, regions and spatial patterns on the Earth's surface.</p> |
| Background | <p>Mount Rainier and Mount Fuji have drastically different morphologies. These differences are due in a large part to the presence of glaciers on Mount Rainier and their absence on Mount Fuji. By comparing the shape and landforms of each of the two volcanoes, students can visualize the incredible role that glaciers have as nature's ice sculptor.</p> <p>Mount Rainier is the most glaciated peak in the continental United States. Although there are taller peaks, none can exceed Mount Rainier's accumulation of approximately one cubic mile of snow and ice in 26 major named glaciers. These glaciers have helped to build Mount Rainier's topography as well as shape and demolish it. As lava flows advanced down Mount Rainier's flanks they were trapped by lobes of glaciers leading to thick, steep, andesite cliff faces full of colonnades (see resources for the "Fire and Ice" lesson to learn more about this process). Glaciers further shaped the mountain's topography by gouging out wide U-shaped valleys radiating from the summit and forming moraines and an abundance of kettle lakes. In addition, glaciers provide loose sediment and runoff that lead to glacial outburst floods and debris flows which then impact both the topography and the ecology of the upper stream valleys.</p> <p>Impacts of these glaciers are not restricted to the flanks of the volcano. Collectively, the glaciers on Mount Rainier are a vast reservoir of water and sediment that have formed catastrophic lahars --filling the downstream valleys and forming the wide, flat, easily farmed valley floors that encircle Mount Rainier. Communities in these valleys such as Orting, Puyallup, Kent, and Fife are built on layers of these lahar sediments. Local acknowledgement of the potential hazards to these river's edge communities and hundreds of thousands of residents has lead to the installation of a lahar warning system in the Carbon and Puyallup River valleys and the creation of lahar evacuation plans.</p> <p>In contrast, Mount Fuji has a smooth conical profile lacking steep ridges, demonstrating the absence of a significant glacial influence on its lava flows and smaller V-shaped river valleys carved by stream erosion. Although Mount Fuji is frequently covered in snow, it has no perennial snow at its surface. There are some lava tubes that are reported to have subterranean ice that would be more accurately called a perma-frost than a glacier. Even with its lack of glaciers, Mount Fuji (like Mount Rainier) does experience debris flows and lahar but usually as a result of rapid snow melt combined with high precipitation events.</p> <p>Glaciers are important sources of freshwater to five rivers and their ecosystems on Mount Rainier. As the global climate has changed, so have the glaciers—retreating further and further up elevation and thinning significantly in some places. The effects of these changes are not completely understood but include making more sediment available for</p> |

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| | <p>transport downstream, an increase in the number of debris flows in upper stream reaches, warmer stream temperatures due to an earlier peak run off and more space for occupation by sub-alpine and alpine ecosystems. Some changes such as more space benefit species by increasing habitat, but others such as sedimentation and warmer streams cause species such as salmonids and amphibians to suffer.</p> <p>The human impact is important as well. The earlier peak stream flow occurs, the less water available for hydropower production—an important renewable energy resource in the Pacific Northwest. Moreover, less water is available for irrigation in the drier areas to the east creating a conflict between the environmental impacts to salmon species and the economical impacts to farmers and consumers. Lastly, as sediments accumulate in streams the elevation of the river bottoms rise increasing the risk of flooding to low lying communities and infrastructure such as occurred in November 2006.</p> <p>Although scientists state that in the past Mount Rainier has probably always had glaciers covering its summit and flanks, they are unsure as to whether they can predict that as its future.</p> <p>Arête—a sharp ridge formed by glaciation Cirque—a bowl-shaped basin, often containing a lake, that forms as a result of glaciation Crevasse—a deep cleft in ice Debris flow—a thick, concrete like flow of water and sediments that may result from a landslide, flooding, or volcanic events such as a pyroclastic or lava flow Esker—a ridge of sediment formed by streams under glacial ice Fjord—a bay with steep cliffs caused by glaciation Glacial trough—a deep U-shaped valley formed by glaciation Glacial outburst flood—a type of debris flow which occurs when melted water from a glacier pools behind a moraine, catastrophically breaks free, and travels down stream picking up sediments Glacier—a mass of ice that accumulates from snow that doesn't melt from year to year Horn—a mountain peak carved by glaciation Kettle lake—a small lake that forms in a basin or depression by melting glacial ice Lahar—a large scale debris flow usually resulting from volcanic processes Moraine—a mound of unpacked sediments that form on the edges (lateral), ends (terminal) or in the middle (medial) of glaciers Perennial—occurring over multiple years</p> |
| <p>Procedure</p> | <ol style="list-style-type: none"> 1. Pre-Activity discussion-- Introduce students to the “system” to be investigated by showing them images of both Mount Rainier and Mount Fuji <ol style="list-style-type: none"> a. Have students define components of the system by looking at the images such as water, plants, rocks etc. Discuss whether a mountain is an open or closed system. b. Discuss where water comes from and the importance of glaciers in a mountain system as a source of fresh water for many uses such as power, irrigation, drinking, plants and animals, recreation |

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| | <ol style="list-style-type: none"> <ol style="list-style-type: none"> c. Ask students to predict whether glaciers are a part of the Mount Rainier or Mount Fuji system and how they might confirm their prediction d. Inform students that they will be doing a webquest to establish some evidence that glaciers might leave behind that would “prove” whether their predictions are correct or not 2. Glacier Webquest--students should follow the instructions provided on the webquest student page. If possible, have students access the page electronically for active links. Students will see many pictures and descriptions of glacially influenced landforms. Students should be looking for evidence that glaciers are or were present in a particular region. 3. Organize students into groups of 4-5 students. 4. As a group, students should make a list of 4-5 pieces of “evidence” that would convince them that glaciers were present. (As an alternative, students can complete the enclosed graphic organizer) 5. Interpreting graphics--Give each group a packet of maps including the relief map of both Mount Fuji and Mount Rainier and the topographic maps for each mountain. 6. Have students use their list of evidence to answer the question, “Are there (were there ever) glaciers on Mount Rainier and Mount Fuji?” according to the rubric provided. 7. Post-Activity Discussion— <ol style="list-style-type: none"> a. Ask students to vote whether each of the mountains have or had glaciers and discuss their reasoning. b. You may also want to discuss that water on Mount Fuji comes from melting snow that feeds aquifers in the ground since there are no glaciers. This same process works at Mount Rainier along with glacial melting. |
| Adaptations / Extensions | <p>If internet is not available, the webquest materials can be printed on a color printer using a print screen function or cut and paste into a PowerPoint format presentation. Some Earth Science texts also contain information about glaciers.</p> <p>Students can complete the “Topographic Maps and Mount Rainier” lesson to search for glacial landforms (see resources for curriculum idea) or the “Fire and Ice” lesson to learn about glacier/lava flow interactions from the <u>Living with a Volcano in your Backyard</u> curriculum.</p> <p>There are many cultural connections to glaciers such as interactions between highland and lowland communities, water-right conflicts, regulatory issues, native perspectives etc that can be used to extend this topic. Some suggested readings include</p> <ul style="list-style-type: none"> • “Glooscap Fights the Water Monster” http://www.firstpeople.us/FP-Html-Legends/GlooscapFightsTheWaterMonster-Passamaquoddy.html a Passamaquoddy legend from Maine. Students can discuss what earth processes are represented by the characters in this legend. • “Deal in the works for water rights settlement with tribe” http://www.greatfallstribune.com/article/20090803/NEWS01/908030306/Deal+in+t |

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| | <p>he+ works+for+water+rights+settlement+with+tribe a news article from the Great Falls Tribune.</p> <p>Students can research a specific glacier in the world or how climate change is affecting a specific glacier or region of glaciers.</p> <p>Students can read Alton Byers' climate witness account (or others) from the WWF website at http://www.panda.org/about_our_earth/aboutcc/problems/people_at_risk/personal_stories/witness_stories/?144261 and write a reflection about why glaciers are important and how they are changing as result of climate change.</p> <p>Students can research the hazards of glacial outburst flooding, hazard mitigation, and historical debris flows on both volcanoes.</p> |
| Suggested Assessment | <p>Student's conclusions can be assessed for accuracy. Their conclusion can be constructed as a five paragraph essay as well.</p> <p>Students can be tested by showing them the outlines of different mountains and predicting if the topography was influenced by glaciers.</p> |
| References/ Resources | <p>Driedger, C., Doherty, A., & Dixon, C. (2005) "Topographic Maps and Mount Rainier." <u>Living with a volcano in you back yard-an educator's guide with emphasis on Mount Rainier.</u> General Information Publication 19. Available on-line at http://vulcan.wr.usgs.gov/Outreach/Publications/GIP19/chapter_three_topographic_maps.pdf</p> <p>Driedger, C., Doherty, A., & Dixon, C. (2005) "Fire and Ice." <u>Living with a volcano in your back yard-an educator's guide with emphasis on Mount Rainier.</u> General Information Publication 19. Available on-line at http://vulcan.wr.usgs.gov/Outreach/Publications/GIP19/chapter_two_fire_and_ice.pdf</p> <p>Granshaw, F., Fountain, A., "Glaciers and glacial change: Gateway to the glaciers of Mount Rainier." Mount Rainier National Park. Available online at http://www.nps.gov/archive/mora/ncrd/glacier/index.html</p> <p>Mount Rainier 1; 100,000 topographic maps can be downloaded from the USGS website http://store.usgs.gov</p> <p>National Aeronautics and Space Administration. "Visible Earth." Additional images available at http://visibleearth.nasa.gov</p> <p>National Snow and Ice Data Center. "All about glaciers." University of Colorado at Boulder. available at http://nsidc.org/glaciers</p> |